Government of the Province of Saskatchewan

DEPARTMENT OF AGRICULTURE

The Management of Drifting Soils

FIELD HUSBANDRY CIRCULAR No. 28

BY

JOHN BRACKEN

Professor of Field Husbandry, College of Agriculture
University of Saskatchewan.

Soil erosion as a result of wind action is one of the most serious problems facing the farmer on some types of soil in the open plains region of the West. It is the first and most emphatic evidence of either poor soil, unsuitable tillage or soil deterioration. During the past three years it has been responsible for the partial or complete destruction of thousands of acres of crop in many different portions of the plains area.

The damage caused by soil drifting is evidenced not only in injury to the crop that may be on the land but also to the soil itself. The seed may be uncovered or blown out of the ground and the young plants may be killed by having their roots exposed, or by being covered up by the drifting particles, or by wounds resulting from the long continued impingement of the drifting particles against the tender tissues of the plant. The soil itself is injured by the removal of much of the surface or more productive part. Aside from these more or less general effects of soil drifting there are other objectionable features such as the possible serious injury to adjoining crops or fields, the spread of weeds and the interference with traffic as a result of the accumulation of drifting soil in road allowances.

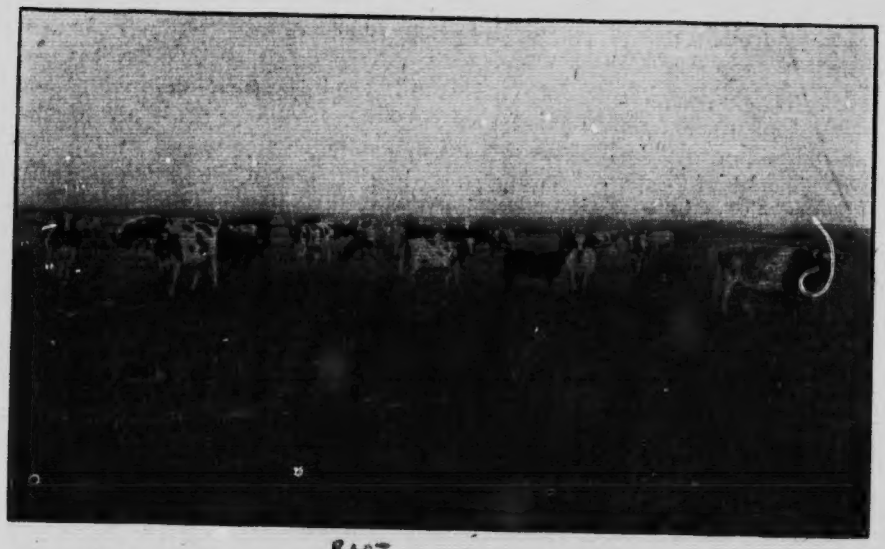
The chief factors favoring soil drifting are a fine textured soil, low precipitation and frequent high winds in early summer before the land is protected by the growing crop. When to these are added too much or unsuitable surface tillage, and a system of farming which is wasteful of soil humus and returns little or no organic matter to the soil, we have a combination of conditions that is responsible, not only for the large losses from soil drifting that have already occurred, but also for preparing the way for still more serious losses in the future if some radical changes are not made in the methods of tillage and cropping heretofore practised in the affected areas. The greatest damage from this cause is to be observed in Southern Alberta, portions of Western and Southern Saskatchewan and in Southwestern Manitoba.

The chief causes of soil drifting are the high wind velocity and the low cohesion or binding force of the exposed soil particles. The wind velocity as well as the frequency of high winds and their general direc-

tion is a climatic condition which cannot be controlled; hence man's only recourse is: (1) to increase the cohesion of the soil particles or their ability to hold together and (2) to reduce the exposure of the surface soil by some form of protection. The means employed to prevent excessive damage from soil blowing therefore fall into two groups: (1) those that increase the resisting power of the soil, and (2) those that protect the soil surface from the wind.

Among the methods used to increase the power of the soil to resist the wind are: (a) increasing the moisture content, (b) increasing the organic matter content, and (c) modifying the structure of the soil. The protection of the soil surface from the wind may be accomplished by: (a) growing a protecting crop, (b) letting the stubble of one crop remain until shortly before the time of seeding the next crop, or, as with corn stubble, through the whole of the next crop season, (c) applying manure or straw to the field, and (d) providing artificial protection such as the growing of wind breaks. We shall take time for a detailed discussion of only the more important of these practices.

Increasing the Moisture Content.—When a soil is moist its particles are not as likely to become separated and blow away as when the soil is dry. This fact is of value chiefly to the farmer on irrigated land where water may be applied at will. Under dry land conditions it becomes of value only in so far as one may by keeping the surface soil firm, also keep it moist to within a very short distance of the surface. The chief value of packing, in the control of soil drifting, is to be found in the fact that it aids in bringing moisture from below to the surface soil, thus increasing the resistance of the particles to the wind. On the other hand if there is not a fair supply of moisture in the lower soil, the breaking up and levelling of the coarse surface particles by the packer will tend to encourage soil blowing. For this reason packing is not a desirable practice in the control of soil drifting on all types of soil.



PERENNIAL HAY CROPS ADD ROOT FIBRE TO THE SOIL, AND ALSO PROTECT IT FROM WINDS.

Increasing the Organic Matter Content.—This is the chief and probably the most permanent means of lessening the danger of soil drifting. The organic matter content may be increased: (1) by growing perennial or biennial hay crops, (2) by applying farmyard manure, or (3) by plowing under green crops. The choice rests between (a) growing grass crops, which in some parts are not considered profitable, or (b) going into stock or mixed farming and hauling manure to the land, or (c) plowing under green crops which has never been shown to be profitable under semi-arid conditions, or (d) doing all of these things.

The use of hay crops for the purpose of adding humus or root fibre to the soil results in: (1) improving the soil as a result of their dense root systems, and (2) providing forage for stock from which manure for further improving the soil may be obtained. The . w yields of hay from perennial grasses under semi-arid conditions is well known, nevertheless the use of such hay and pasture crops furnishes what is probably the best means of maintaining the organic matter of much of our lighter soils. Brome grass, owing to its very dense root system, is probably the best for this purpose. Sweet clover promises much, not only as a forage crop but also as a soil improver. It has one advantage over brome grass in that it is a legume. It therefore leaves the soil richer in nitrogen than does brome grass, but the latter probably leaves more root fibre.

The chief value of manure is not in its content of plant food; the organic matter which it contains increases the power of the soil to hold moisture and to resist blowing. On drifting soils the only argument against the use of manure when intelligently applied is the cost of applying it. The application of manure as a surface dressing on the more exposed portions that are likely to blow first is a preventive measure that should come into general practice.

The plowing under of weeds in the fallow year, or the early spring growth of sweet clover or of the perennial grasses, is probably the only green manuring it will be found profitable to practice in our dry areas at the present time. The growing of green crops through a whole season in order to have a large growth to plow under to increase the organic matter content of the soil will not likely ever come into general use in the West, for the reason that the organic matter thus added to the soil is secured at the expense of an enormous quantity of soil moisture which is itself generally the limiting factor in crop yields. On soils that are low in organic matter in areas of light rainfall, it is questionable how far this practice may be carried before its waste of soil moisture will result in making the remedy more to be feared than the disease.

Modifying the Structure of the Soil.—Soil drifting occurs chiefly on the fine textured soils—the sandy types and the heavy clays that slake down to a fine powdery condition on top. The fallow generally suffers the most, although fall plowed land is not free from erosion and spring plowed land on some soil types occasionally blows. The smaller the soil particles are and the drier they are the greater the probability of their blowing away. The problem is therefore one of preventing the soil becoming too fine and too dry on top. The drying out of the top layer cannot be prevented but the formation of a fine "dust" mulch may be, at least on most soils. The use of the unfortunate term "dust mulch" in so much of the Western Canadian and American agricultural

literature, is responsible for at least a portion of the excessive drifting that has occurred in recent years. The "dust" mulch has no place in the agriculture of any dry country where high winds prevail. A rough cloddy surface developed by deep cultivation and preferably left in small ridges by a cultivator is to be preferred.

On drifting soils the cultivator should take the place of the disc and harrows on the fallow field. Once harrowing after the plow, in order to level the surface, is all the harrowing such a fallow needs if the soil is prevented from baking or cracking and the weeds prevented from growing by the use of the cultivator. More care in plowing in order to secure a level surface, and the use of the packer (preferably the sub-surface type) behind the plow, are practices that are making harrowing less necessary and are proving to be more efficacious in lessening soil drifting. A ridged surface such as is left by the cultivator provides a refuge for the fine particles in the bottom of the narrow ridges, and in practice is found to result in less blowing and in the production of greater returns than a smooth surface. Working the soil when it is dry should be discouraged. When it is slightly moist below the surface a more granular or lumpy top can be developed than if tilled when dry.

The use of the press drill leaves the soil in better condition to withstand the effects of the wind than the use of most other types. The single disc is particularly undesirable on soils that drift.

Shallow soils or those having a deficiency of organic matter in the subsoil should not be plowed deep, or they will soon begin to blow. The surface layer of such soils is richer in organic matter and therefore much more resistant to the wind than the lower layers when the latter are turned up on top. This does not apply to deep soils nor to those having a subsoil which is not likely to blow.

Growing Protecting Crops.—The most serious drifting occurs in May before the spring sown crops cover the ground; but winter drifting is not uncommon in years of light snowfall following a dry autumn season. In those areas where drifting is quite common the only fields that can be depended upon to wholly resist the wind action, under severe conditions, are those that are protected by a crop or by unplowed stubble.

Perennials as Protecting Crops.—The best protecting crops, although often the least profitable, are the perennials. Among these the grasses are to be preferred, although alfalfa and sweet clover (a biennial) are equally as good soil protectors. It is very seldom that crops sown on land broken up out of sod suffer from soil drifting. In 1919 such land produced almost an average yield at Saskatoon while many crops on fallow and fall and spring plowing were partial or complete failures.

Winter Rye Lessens Drifting.—Another commonly grown crop but one less sure of furnishing the protection needed is winter rye. This crop, like the perennials mentioned, may be sown in or following the rainy season when the soil seldom blows, and by covering the ground in May is, like the others, likely to lessen or entirely prevent any blowing. The question of growing winter rye is one that deserves consideration by all farmers living in soil drifting areas. Where drifting interferes

with wheat raising to such an extent as to make it unprofitable, winter rye, in many cases, may be substituted to advantage. As a commercial crop, however, rye generally sells for twenty-five to thirty per cent. less than wheat, so that where the latter can be satisfactorily grown rye cannot compete with it as a profitable crop. The illustration shows very convincingly the relative resistance to drifting of land protected by winter rye as compared with that sowed to oats, a spring sown crop.

WINTER RYE GROWING BESIDE AN OAT FIELD ON SOIL THAT DRIFTS. THE OATS WERE PRACTICALLY A FAILURE, THE RYE WAS UNHURT EXCEPT FOR 10 OR 20 FEET ALONG THE EDGE WHERE THE SOIL FROM THE OAT FIELD BLEW INTO THE RYE FIELD.

Late Sown Oats for Soil Protection.—Where the conditions are not so serious as to require the use of one or more of these crops but where some protection of the soil is desirable, a very thin seeding of oats or other cereal may be sown on the fallow in late July or early August and lightly pastured if necessary. These plants, of course, die in winter, but the roots and leaves remaining furnish considerable protection against the high winds the following May. An objection to this practice is to be found in places where biennial weeds are prevalent. If these start after the cover crop is sown in July they will, of course, be present in the crop the next year, as no opportunity to kill them in the fall offers itself, the ground being occupied by the cover crop which would be destroyed if cultivated. A volunteer growth of grain or annual weeds in late summer has a similar effect to the sowing of a thin crop of oats, but is subject to the same objections, viz., the possible presence of biennial weeds which will live over and appear in the next crop.

Stubble as a Soil Protector.—Where soil drifting occurs on fall plowed land in winter or in spring two alternatives present themselves, spring plowing or "stubbling in." In much of the very dry portions of the plains region, even aside from the question of soil drifting, spring plowing is rather to be preferred to fall plowing. Where these

conditions obtain, of course, all the advantages are with the spring plowing because such land is protected in winter and generally blows less than fall plowing even in the spring. "Stubbling in" is only advisable on land that is free from weeds and grass and that is in good physical condition. In the dry parts and on new land it is more frequently followed than elsewhere. Such fields, of course, benefits as a result of protection in the early summer as well as in the preceding winter.

Corn Stubble Lessens Drifting.—On warm soils in the southern part of all three provinces corn may be used as a partial substitute for the fallow. Where fallow land in such areas drifts badly, the use of corn as a substitute for fallowing lessens the tendency to drift. Under severe conditions the corn ground will blow, but frequently the corn stubble furnishes sufficient protection to wholly prevent serious injury from this cause. Where corn is grown and the field kept free from weeds, plowing is, as a rule, not necessary or even advisable for the next crop. Discing the corn stubble generally gives better returns. This practice results in leaving the corn stubble on the surface of the soil where they form a considerable protection against soil drifting.

Artificial Protection.—The value of windbreaks such as clumps of trees, hedges, fences, etc., is in direct proportion to their height and extent. Depending upon the severity of the storm the land adjoining such windbreaks is generally protected from ten to twenty times the height of the windbreak, although instances have been reported where such protection is felt over a much greater distance. As a means of lessening soil drifting windbreaks are practicable only for small areas. No doubt when shelter of this kind becomes established on all farms the wind velocity will be lessened somewhat, but the cost of planting and maintaining will probably be found to be too great to warrant planting out enough trees to make any appreciable effect on the wind velocity on large farms in the open plains. Where windbreaks such as hedges or fences are used to protect the farmstead or the garden, an outer row, a few rods from an inner one, should be provided in order to form a "trap" for the drifting soil, otherwise the drift will accumulate within the enclosure and become a nuisance in the carrying out of the necessary farm operations.

Miscellaneous Practices and Suggestions.—In fields where the soil has begun to blow much can be done to check it by going into the field and plowing narrow strips of four to six furrows from five to twenty-five rods apart, at right angles to the direction of the winds. These raised portions act as checks behind which the drifting particles lodge. This is an extreme measure and is only advisable where a small patch of drifting soil promises to do serious injury to adjoining areas that are not likely to blow if the drifting material can be kept away from them.

Arranging the areas to be seeded in long strips rather than approaching the square will also counteract the injurious effects of the soil drifting to a certain extent.

By sowing the grain deeper than usual, thus leaving the soil furrowed, tends to prevent soil drifting and lessens the probability of the seed or the plant roots becoming exposed.

The sandy soils take more permanent injury from drifting and are much less subject to favorable modification by tillage than the clay

types; the maintenance or increase of the organic matter content by applying manure and growing grass or legume crops becomes therefore of much greater importance with these than with heavier soils.

The introduction of perennial grasses to the rotation in dry districts should be made gradually, otherwise there may be difficulty in adjusting the farm organization to the change. It is hardly necessary to point out that if the cropping system is altered to include the growing of the forage grasses and legumes, provision for the economical utilization of this forage should also be carefully planned otherwise the benefit to the soil arising from the change may be secured at too high a price.

As curative measures after soil starts to blow there is very little effective treatment that can be given. Where isolated spots only are affected, such as light knolls or exposed elevations, spreading manure either in strips or over the whole surface will lessen the injury. Plowing a few furrows in strips five to ten rods apart on the lee side of such drifting areas, while a very drastic measure, is one that is advisable where a small area of drifting soil in a larger area of good soil is likely to result in injury to the whole if not controlled in the early stage of the blowing. The drifting particles that leave such light areas may during the course of several days of blowing affect several parts of the field, since they move readily from one place to another, doing injury at every move. It thus happens that from one small patch of poor land a large acreage may be severely damaged if drastic measures are not taken in the early stage of the storm.

Conclusion.—The fallow is the worst to suffer from soil drifting, and the danger is greatest in May but may occur in winter. The damage is increased when such surface tillage as discing and harrowing, which tend to make the soil fine and loose on top, is practised; it is lessened by deeper tillage with cultivators which leave the soil in a rough, more or less lumpy condition, and preferably in shallow ridges. If this treatment is not sufficient to control the drifting a thin seeding of oats may be sown on the fallow in July and August, or in some districts corn may be used as a partial substitute for the fallow. In case one or other of these fails to produce the desired results, winter rye, which establishes itself in the fall and which has possession of the ground in May, and is therefore likely to prevent the blowing, may be used. Under more serious conditions of soil drifting it may be necessary to grow perennial or biennial crops and sow cereals only on the sod land, or to so build up the organic matter content of the soil by using hay and pasture crops and farmyard manure, that when intelligently tilled the land will not be likely to blow.